

In section 2 of the Detailed Action, dependent claim 12 was objected to because of the noted informality. By this Amendment, the noted informality has been corrected as suggested to overcome this objection.

In sections 4 and 5, independent claims 1, 24 and 44 as well as dependent claims 2, 9-12, 18 and 25-26 were rejected as being anticipated or obvious over the Kuhn patent. However, for the following reasons, it is submitted that these claims are now all allowable.

The principal amendments to claims 1, 24 and 44 have been made to make it clear that the coherent light emitted by the source of coherent light remains coherent and in fact impinges upon the sample as coherent light. In the response to applicant's previous arguments, the examiner points out that the Kuhn patent discloses the use of one or more lasers. As then noted by the Examiner, the Kuhn patent thus provides coherent light. However, the output of those lasers in the Kuhn patent is used in creating a source of polychromatic light, so that the light actually used in the apparatus of the Kuhn patent is *incoherent*. As explained by the Kuhn patent at column 5, line 21:

However constructed, the only requirement is that light source 32 emit more than one wavelength so that depth distance may be determined by the spectral spread of affected light.

Thus, as explained in applicant's previous submission, the polychromatic nature of the light source is fundamental to the invention of the Kuhn patent, as that focuses the polychromatic light at different distances according to wavelength so that the nature of the return spectrum can provide a measure of the distance to the target and hence the surface profile. Polychromatic light, however, is necessarily incoherent. The various components of incoherent light will travel at different speeds through the optical

elements, and will be refracted through different angles by those elements. It is impossible for the wave fronts of such light to remain in phase (or coherent). This is both an inevitable and in fact required property of the technique of the Kuhn patent, as would be well recognized by those of ordinary skill in the art.

In amended claims 1, 24 and 44, it is thus now made clear that the light from the source of coherent light remains coherent through the entire optical path from the light source to the sample. Thus, although both the approaches of the present invention and of the Kuhn patent may use lasers to provide the light, claims 1, 24 and 44 as amended are clearly distinguished from the disclosure of the Kuhn patent in preserving and utilizing the coherence of that light (which coherence would render unusable the device of the Kuhn patent).

Further, there is no teaching of the present invention or of any technique in the Kuhn patent where coherent light is used in the manner defined in the claims of this application. It is submitted, therefore, that claims 1, 24 and 44 and claims depending therefrom are novel and inventive over the disclosure of the Kuhn patent and thus should be allowable

The Examiner also objects that the scope of "a small angle" in claims 1 and 24 is sufficiently broad to encompass the disclosure of the Kuhn patent, on the basis that any angle is "small" if compared with a sufficiently large alternative. In particular, the examiner states that "small" is a relative term. While this is true in the abstract, those of ordinary skill in this art would hardly say that 90° is "small" when comparing the deviation of one beam from another. In fact, those of ordinary skill would instead assert that a deviation of 90° is the "maximum" deviation as such beams would then be

perpendicular - and a deviation of 360° or 180° would be equivalent to no deviation (at least where direction is not considered as in the present context). Thus, "small" in the context of the present invention would necessarily mean to those of ordinary skill that it is small compared to 90° and the use of such a term would not be considered to encompass the 90° deviation shown in the Kuhn patent.

However, in order to make even clearer that the present invention differs substantially from that shown in the Kuhn patent, claims 1 and 24 have been amended to be consistent with the present disclosure (particularly as shown in the accompanying figures) and the understandings of those of ordinary skill, whereby the "small" angle of divergence is small relative to 90° . That this is the appropriate comparison is also made clear from page 1 of the specification, in which it is explained that apparatuses of the prior art "are both relatively bulky and designed to function efficiently only when the two exit bends diverge at a relatively high angle (which is often approximately 90°)" [page 1 lines 11 to 14]. This passage continues to explain that conventional bends splitters "are generally 45° cubes or pellicles or are near orthogonal to the optic axis...", which also—in all three cases—implies a (maximum) divergence of 90° .

As was explained in a previous submission, beam splitter 152 of the Kuhn patent can be regarded either as deviating the light by 90° (like the prior art discussed in the present application) or as displacing each individual beam of light by the entire diameter of lens 112 relative to the incident beam. In either case, the arrangement of the Kuhn patent does not meet the limitation of claims 1 and 24 as amended.

In addition, claims 1 and 24 as amended no longer refer to "or displaced" by a small "distance", as this is an effect of the small deviation rather than an actual

alternative and as such is unnecessary and possibly confusing. This is clear in, for example, Figure 4 in which the small deviation introduced by triplet 80 leads to a small displacement between incoming beam 88 and exiting beam 90. The critical feature, however, is the small deviation introduced by triplet 80.

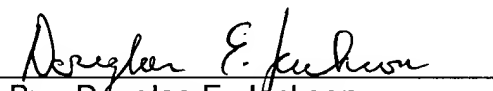
Therefore, for all of the foregoing reasons, it is submitted that independent claims 1, 24 and 44 are all allowable over the Kuhn patent. For these same reasons, it is submitted that claims 2, 9-12, 18 and 25-26 dependent from these claims are similarly allowable. Likewise, non-elected claims 3-8, 13-17, 19-23, 42-43 and 45-47 which now depend from an allowable elected independent claim as also allowable.

As noted above, non-elected independent claims 48 and 56 have also been amended. These non-elected independent claims have been amended in the same manners as independent claims 1 and 24, so that these claims will be allowable in at least the same manner as the elected independent claims. In addition, non-elected dependent claims 49-55 and 57-62 dependent respectively from non-elected independent claims 48 and 56 are thus also allowable therewith.

Further and favorable action is solicited.

Respectively Submitted,

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ATTACHMENT B

Marked Up Copy of Amended Claims

Following herewith is a marked up copy of each rewritten claim together with all other pending claims (for convenience, those claims directed to the non-elected embodiment have been shaded).

1. (twice amended) A confocal endoscope or microscope including:
 - a light source of coherent light for illuminating a sample;
 - a beam splitter; and
 - light receiving means for receiving coherent light from said light source, (1) wherein an incident beam of coherent light from said light source is directed onto said beam splitter and hence onto said sample as coherent light, and (2) wherein light returning from said sample and incident on said beam splitter is deviated ~~or displaced~~ by said beam splitter by an small-angle or distance relative to said incident beam that is small relative to 90° and is then received by said light receiving means, said light receiving means ~~being~~ located to receive said returning light and near said light source.
2. A confocal endoscope or microscope as claimed in claim 1, including an optical head and said light source is located in or on said head.
3. A confocal endoscope or microscope as claimed in claim 2, including heating means for maintaining said head at a temperature substantially equal to that of said sample.
4. A confocal endoscope or microscope as claimed in claim 1, wherein said light source and said light receiving means are on a single mounting means.
5. A confocal endoscope or microscope as claimed in claim 4, wherein said beam splitter is mounted on said mounting means.
6. A confocal endoscope or microscope as claimed in claim 4, wherein said mounting means is moveable for scanning said light source.

7. A confocal endoscope or microscope as claimed in claim 4, wherein said mounting means includes a reed.

8. (amended) A confocal endoscope or microscope as claimed in claim 4, wherein said mounting means is an electromagnetically vibrated reed.

9. A confocal endoscope or microscope as claimed in claim 1, wherein said light source and said light receiving means are adjacent or touching.

10. (amended) A confocal endoscope or microscope as claimed in claim 1, wherein said light source is an optical fiber tip.

11. (amended) A confocal endoscope or microscope as claimed in claim 1, wherein said beam splitter includes a plurality of optical elements selected from prisms, lenses, or both prisms and lenses.

12. (thrice amended) A confocal endoscope or microscope as claimed in claim 11, wherein said plurality of optical elements provide net deviation or translation, so that said coherent light and said light returning from said sample respectively emerge from said plurality of optical elements substantially parallel to and optically coaxial with its a respective path immediately before impinging said plurality of optical elements.

13. (amended) A confocal endoscope or microscope as claimed in claim 11, wherein said plurality of optical elements is arranged to focus confocal return stokes fluorescence to form a line, said line forming a spectrum in which shorter wavelength fluorescence is located towards a first end of said line closer to said light source, while longer wavelength fluorescence is located towards a second end further from said light source.

14. A confocal endoscope or microscope as claimed in claim 1, including means to allow light on either side of a spectral line in said returning light to be included with light from said spectral line when said returning light impinges on said light receiving means.

15. A confocal endoscope or microscope as claimed in claim 14, wherein said means is controlled by a mechanism which occludes light which is more distant in wavelength than a desired amount from said spectral line, to allow control of depth of field isolation.

16. (amended) A confocal endoscope or microscope as claimed in claim 14, including optical elements to divert chosen wavelength portions of said spectral line to one or more photodetectors to give different spectral channels for imaging.

17. A confocal endoscope or microscope as claimed in claim 1, including at least one optical waveguide channel to convey said returning light to said photodetectors.

18. A confocal endoscope or microscope as claimed in claim 1, including a laser and an optical waveguide to convey light from said laser to said light source.

19. A confocal endoscope or microscope as claimed in claim 1, including a first optic waveguide to convey light to said specimen and at least one second optic waveguide channel to convey said returning light to said photodetectors, and said beam splitter is disposed in said head between said first and second optic waveguides.

20. (amended) A confocal endoscope or microscope as claimed in claim 1, including a return fiber and wherein said beam splitter is located between a light exit area of said return fiber and said photodetectors, to provide spectral separation after said returning light exits said fiber.

21. A confocal endoscope or microscope as claimed in claim 1, including an aperture slit moveable in front of said photodetectors simultaneously with said scanning to compensate for changes in beam splitter deviation.

22. A confocal endoscope or microscope as claimed in claim 11, wherein said plurality of prisms and/or lenses include at least one apochromatic lens.

23. A confocal endoscope or microscope as claimed in claim 11, wherein said prisms and/or lenses include an SF 11 or SF 59 prism.

24. (twice amended) A method for performing confocal endoscopy or microscopy including the steps of:

illuminating a sample by means of an incident or excitatory beam of coherent light that impinges upon said sample as coherent light; and

~~deviating or displacing~~ light returning from said sample by an small-angle or distance relative to said incident beam that is small relative to 90°.

25. A method as claimed in claim 24, including receiving or detecting said returning light at a point close to a source of said incident or excitatory beam.

26. A method as claimed in claim 24, wherein said deviating or displacing of said light returning from said sample is effected by means of a beam splitter.

42. A confocal endoscope or microscope as claimed in claim 1, wherein said light source comprises a mirror located in the path of the returning light for directing light towards said sample, wherein said mirror has a smaller solid angle than said returning light to only partially occlude reception of said returning light by said light receiving means.

43. A confocal endoscope or microscope as claimed in claim 42, wherein said mirror and said light source are provided on a single piece of silicon and said mirror comprises an etched mirror surface of the silicon.

44. (twice amended) A method for performing confocal endoscopy or microscopy including the steps of:

illuminating a sample by means of an incident or excitatory beam of coherent light that impinges upon said sample as coherent light and thereby inducing a broader beam of returning light; and

detecting a portion of said returning light adjacent to or near said incident beam.

45. A method as claimed in claim 44, including directing said incident light towards said sample by means of a mirror located in the path of said returning light, wherein said mirror has a smaller solid angle than said returning light to only partially occlude reception of said returning light.

46. A method as claimed in claim 45, wherein said mirror and the source of said incident light are provided on a single piece of silicon and said mirror comprises an etched mirror surface of the silicon.

47. (new) A confocal endoscope or microscope as claimed in claim 16, wherein the optical elements also divert light close in wavelength to said spectral line.

48. (amended) A confocal endoscope or microscope including:

a light source of coherent light for illuminating a sample;

a beam splitter; and

light receiving means for receiving coherent light from said light source, wherein (1) wherein an incident beam of coherent light from said light source is directed onto said beam splitter and hence onto said sample as coherent light, and (2) wherein light returning from said sample and incident on said beam splitter is deviated by said beam splitter by an small angle relative to said incident beam that is small relative to 90° and is then received by said light receiving means, said light receiving means ~~being~~ located to receive said returning light and near said light source; and

wherein said beam splitter includes polarization rotating means and deviation means to separate light of different polarizations, and operates by optically rotating said coherent light and said returning light.

49. A confocal endoscope or microscope as claimed in claim 48, wherein said polarization rotating means is based on optical rotary dispersion and includes a chiral medium to optically rotate said coherent light and said returning light.

50. A confocal endoscope or microscope as claimed in claim 48, wherein said polarization rotation means includes a Faraday effect material, said material having simultaneously magnetic lines of force in the same direction as the propagation direction of said light, whereby the E vector of said coherent light is rotated as it passes through said material .

51. A confocal endoscope or microscope as claimed in claim 48, wherein said polarization rotation means includes phase plates or retardation elements, of a material whose structure is anisotropic at a molecular or crystalline level.

52. A confocal endoscope or microscope as claimed in claim 48, wherein said polarization rotation means includes liquid crystals.

53. A confocal endoscope or microscope as claimed in claim 52, wherein said liquid crystals are optically active and/or birefringent.

54. A confocal endoscope or microscope as claimed in claim 52, wherein said liquid crystals are cholesteric liquid crystals.

55. A confocal endoscope or microscope as claimed in claim 48, wherein said optical rotation is provided by intrinsic polarization properties of the sample or of any intermediate optical medium.

56. (amended) A method for maintaining registration in a confocal endoscope or microscope including a coherent light source and a light receiving means, including the steps of:

splitting light returned from a sample with an small-angle deviation beam splitter whose angle of deviation is small relative to 90°;

employing said coherent light source and said light receiving means located on a single moveable mounting means; and

moving said mounting means to scan said coherent light source and thereby to scan said sample with coherent light.

57. A method as claimed in claim 56, wherein said beam splitter includes a plurality of optical elements selected from prisms, lenses, or both prisms and lenses.

58. A method as claimed in claim 57, wherein said plurality of prisms and/or lenses provide a net deviation which is minimal.

59. A method as claimed in claim 57, including moving said beam splitter with said light source and said light receiving means.

60. A method as claimed in claim 56, wherein said moving of said mounting means comprises vibrating said mounting means.

61. A method as claimed in claim 56, wherein said mounting means is a reed.

62. A method as claimed in claim 56, wherein said mounting means is an electromagnetically vibrated reed.